



Energy Technologies Area

Lawrence Berkeley National Laboratory

Overview on U.S. Appliance Efficiency Standards and New Research Areas

美国电器能效标准概况和最新研究领域

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Seventh China-U.S. Energy Efficiency Forum 第七屆中美能效论坛

Beijing: October 13, 2016 北京, 2016年10月13日

Lawrence Berkeley National Laboratory 劳伦斯伯克利国家实验室简介

Managed by the University of California for the United States Department of Energy

隶属美国能源部，由加州大学伯克利分校代为管理



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U.S. LBNL Energy Efficiency Standards Group

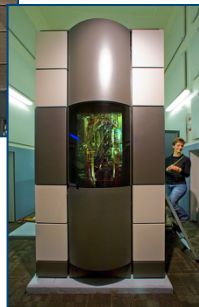
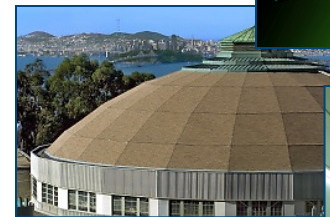
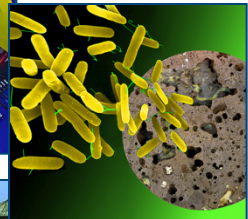
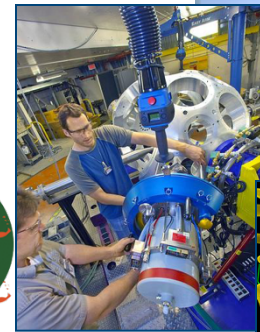
美国能效标准研究组

- Working on U.S. standards since mid-1980s
自80年代以来一直致力于研究制定美国能效标准
- 50 researchers
50位研究人员

China Energy Group 中国能源研究室

- Founded in 1988 建于1988年
- 15 staff, 15 visiting researchers from China
15位研究员工，15位来自中国的研究人员
- Collaboration with CNIS on appliance efficiency since late 1990s
自90年代以来一直与中国

国家标准研究院合作

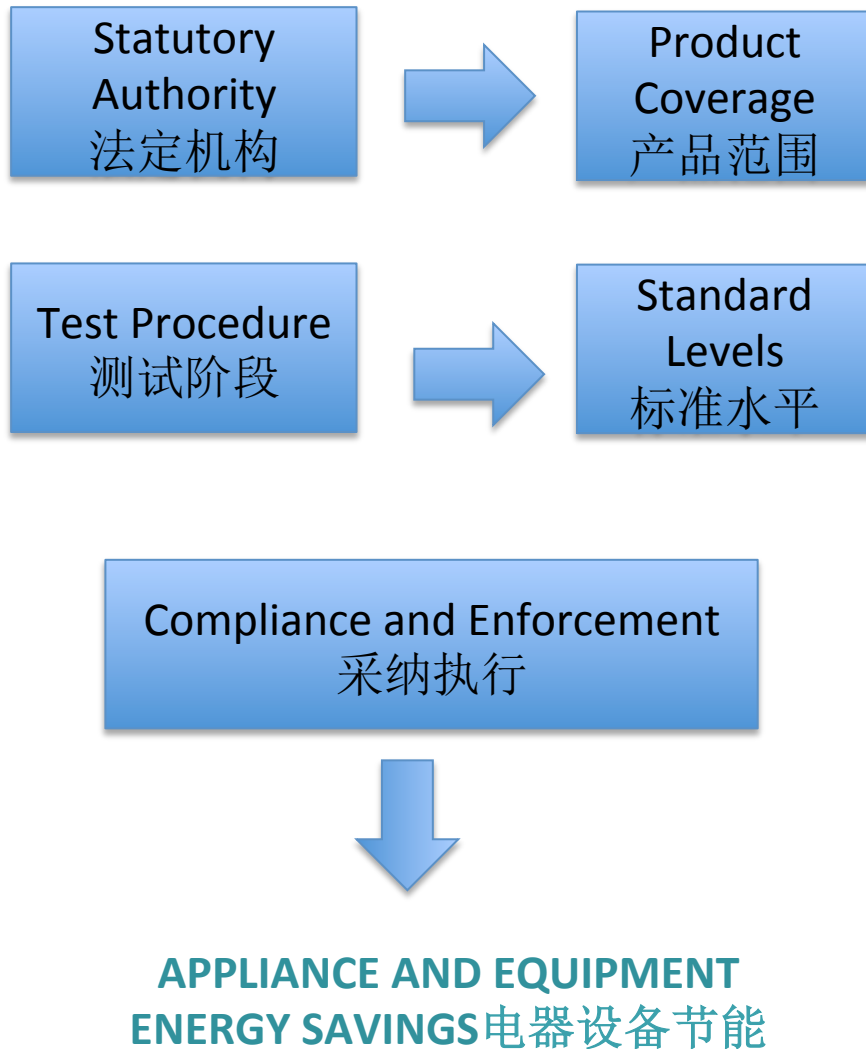


Outline纲要

- ◆ Overview of U.S. efficiency standards program
美国能效标准简介
- ◆ Potential impacts of standards: U.S. and China
标准的潜在节能效果：美国和中国
- ◆ New research and potential areas of collaboration
最新研究及合作领域

Development of U.S. Energy Efficiency Standards

美国能效标准发展历程



U.S. Appliance Standards Program

美国能效标准项目

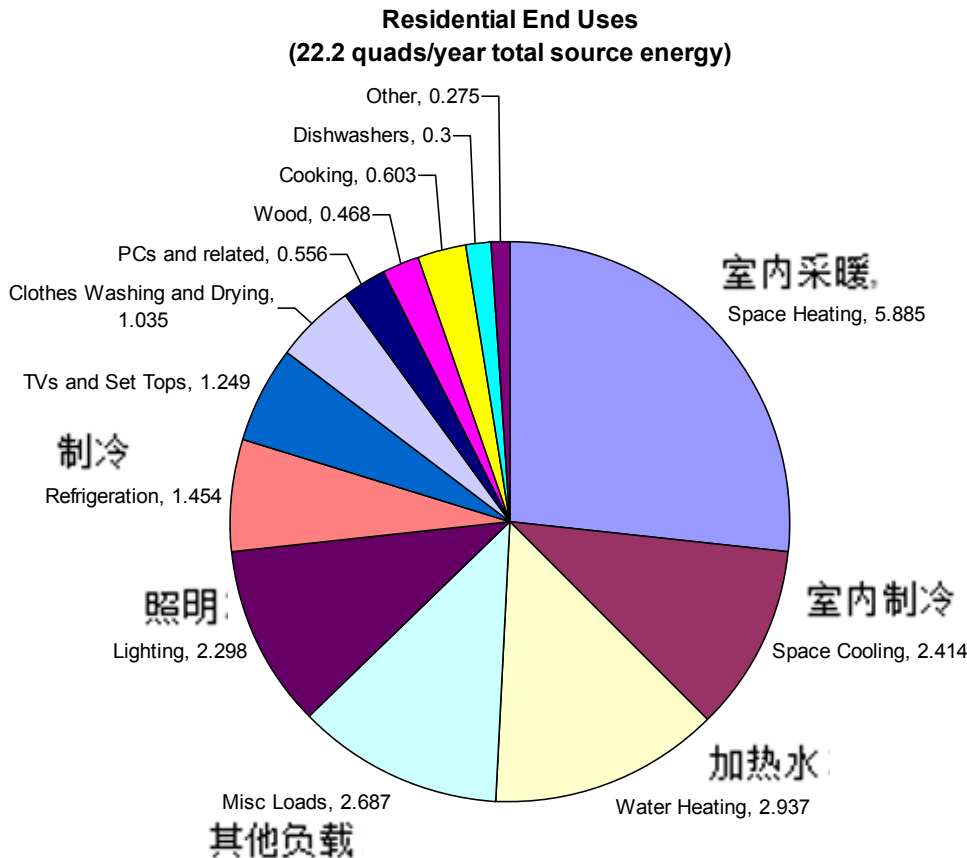
- established by the **U.S. Congress** in 1975 to develop energy efficiency standards
美国国会于**1975**年通过力争改善能效标准
- public process combines **economic** and **engineering analyses** with **stakeholder input**; and
公共透明过程，包含经济技术分析并采纳利益相关者意见
- develops **technologically feasible** and **economically justified** appliance standards that deliver **significant energy savings**
制定技术经济可行的电器能效标准以达到最大的节能效果

电器能效标准是政府气候变化行动方案的三大重点之一

- ◆ Sets a goal to reduce carbon pollution by 3 billion metric tons cumulatively by 2030 through efficiency standards
2030年目标:通过节能标准减少30亿吨二氧化碳排放
- ◆ LBNL supports this goal by developing economic analysis approaches to improve estimates of benefit-cost analysis and to address government and stakeholder concerns
劳伦斯伯克利实验室分析经济净效益以帮助实现此目标,并回答各级政府 and 利益相关者提出的疑问
- ◆ LBNL also supports DOE and ENERGYSTAR Test Procedures, as well as certification, compliance and enforcement
劳伦斯伯克利实验室也支持美国能源部与能源之星的测试方法,认证,合格性验证,执行

Annual U.S. Primary Energy Consumption

美国年均一次能耗情况



美国居民建筑能耗量: 8 亿吨标煤

U.S. Residential Total: 800 Mtce

Note: 1 Quad = 1.055×10^{12} MJ

DOE's Appliance Standards program covers **more than 60 appliance and equipment categories** that address 美国能源部能效标准包括60多种电器设备种类:

- 90% of home energy use
90% 家用能耗
- 60% of commercial building energy use
60% 公建建筑能耗
- 30% of industrial energy use
30% 的工业部门能耗

Source: DOE Office of Energy Efficiency & Renewable Energy

Standards History since 2007: Program Expansion

2007年以来的标准发展历程

- ◆ EISA 2007 and stakeholders push DOE to refocus on the Appliance Standards Program
2007年EISA和利益相关者促使能源部重新重视能效标准项目
- ◆ Current U.S. Administration puts an emphasis on standards to save energy and carbon 现任政府重视标准的节能减碳效应

One Final Rule in 2007

1. Liquid-Immersed Distribution Transformers

Two Final Rules in 2008

1. Packaged Terminal AC and Heat Pumps
2. Commercial Refrigeration Equipment

Four Final Rules in 2009

1. Standards prescribed by EISA 2007: 14 products
2. General Service Fluor. Lamps & Infrared Lamps
3. Commercial Package Boilers and Very Large Commercial Package AC & Heat Pumps
4. Refrigerated Beverage Vending Machines

Five Final Rules in 2010

1. Ranges and Ovens
2. Commercial Clothes Washers
3. Water Heaters (Residential)
4. Direct Heating Equipment & Pool Heaters
5. Small Electric Motors

Five Final Rules in 2011

1. Residential Refrigerators and Freezers
2. Furnaces and Central AC & Heat Pumps (Resid.)
3. Fluorescent Lamp Ballasts
4. Clothes Dryers (Residential) and Room AC
5. Vented Hearth Products

Three Final Rules in 2012

1. Commercial Water & Evap-Cooled AC, VRF Water-Source HPs, CRACs
2. Residential Clothes Washers
3. Residential Dishwashers

2007年一条条例

1. 液浸式变压器

2008年两条条例

1. 包装终端空调和热泵
2. 公建建筑冰箱设备

2009四条条例

1. EISA 2007授予标准：14种产品
2. 通用荧光灯；红外灯
3. 商用锅炉和大型公建设备以及热泵
4. 冷藏饮料自动售货机

2010年五条条例

1. 炉头及烤箱
2. 商用洗衣机
3. 家用热水器
4. 直接采热设备及泳池加热设备
5. 小型电动机

2011年五条条例

1. 家用冰箱冷冻柜
2. 炉灶和中央空调及家用热泵
3. 荧光灯镇流器
4. 家用烘干机及单体空调
5. 排出炉膛热水器

2012年三条条例

1. 商用水冷和蒸发冷却式空调、变制冷剂流量水源热泵、机房空调
2. 家用洗衣机
3. 家用洗碗机

U.S. Standards History since 2012

2012年以来的美国标准历史

Two Final Rules / One Voluntary Agreement in 2013

1. Distribution Transformers
2. Microwave Ovens
3. Set-Top Boxes (voluntary agreement)

Ten Final Rules in 2014

1. External Power Supplies
2. Metal Halide Lamp Fixtures
3. Commercial Refrigeration Equipment
4. Through-the-Wall Central Air Conditioners and Heat Pumps
5. Walk-In Coolers and Freezers
6. Medium Electric Motors
7. Furnace Fans (Residential)
8. Commercial Clothes Washers
9. General Service Fluorescent Lamps
10. Automatic Commercial Ice Makers

Twelve Final Rules in 2015

1. 3-Phase Central ACs and Heat Pumps, Water-Source Heat Pumps, Commercial Oil-Fired Storage Water Heaters
2. Packaged Terminal Air Conditioners and Heat Pumps
3. Single Package Vertical Air Conditioners and Heat Pumps
4. Walk-in Coolers and Freezers
5. Grid-enabled Water Heaters
6. Commercial Air-Cooled Air Conditioners and Heat Pumps, Commercial Warm-Air Furnaces
7. Residential Boilers
8. Ceiling Fan Light Kits
9. Commercial and Industrial Pumps
10. Refrigerated Beverage Vending Machines
11. HID Lamps
12. Pre-rinse Spray Valve

2013年2项条例与1项自愿协议

1. 配电变压器
2. 微波炉
3. 机顶盒
4. 短灯排斥

2014年10条条例

1. 金卤灯灯具
2. 商用制冷设备
3. 墙内空调及热泵
4. 商用冷冻柜
5. 中型电动机
6. 家用炉灶风机
7. 商用洗衣机
8. 通用荧光灯
9. 商用自动制冰机

2015年12条条例

1. 三级中央空调和热泵，水源热泵，商用储油式热水加热器
2. 一体式空调机组和热泵
3. 单体式立式空调和热泵
4. 步入式冷却器和冷冻柜
5. 网格式热水器
6. 商用风冷式空调机和热泵；商用风热式炉灶
7. 家用锅炉
8. 吊扇灯
9. 商用及工业用途泵机组
10. 冷藏饮料自动售货机
11. 高强度放电灯
12. 预清洗喷淋阀

DOE Appliance Standards Program has been cost-effective at saving energy 能源部电器标准节能且经济效益好

National Benefits of Energy Efficiency Standards Completed Through 2015

到2015年所完成的能效标准的国家效益

	Through 2020 到2020年	Through 2030 到2030年
National Energy Savings 全国节能量	70 quads (25.2亿吨标煤)	130 quads (43.2亿吨标煤)
Cumulative Consumer Utility Bill Savings 累积消费者电力帐单储蓄	\$1 trillion (1万亿\$)	\$2 trillion (2万亿\$)
Annual Carbon Dioxide Savings 年度二氧化碳减排	345 million tons (3.45亿吨)	7.9 billion tons (79亿吨)

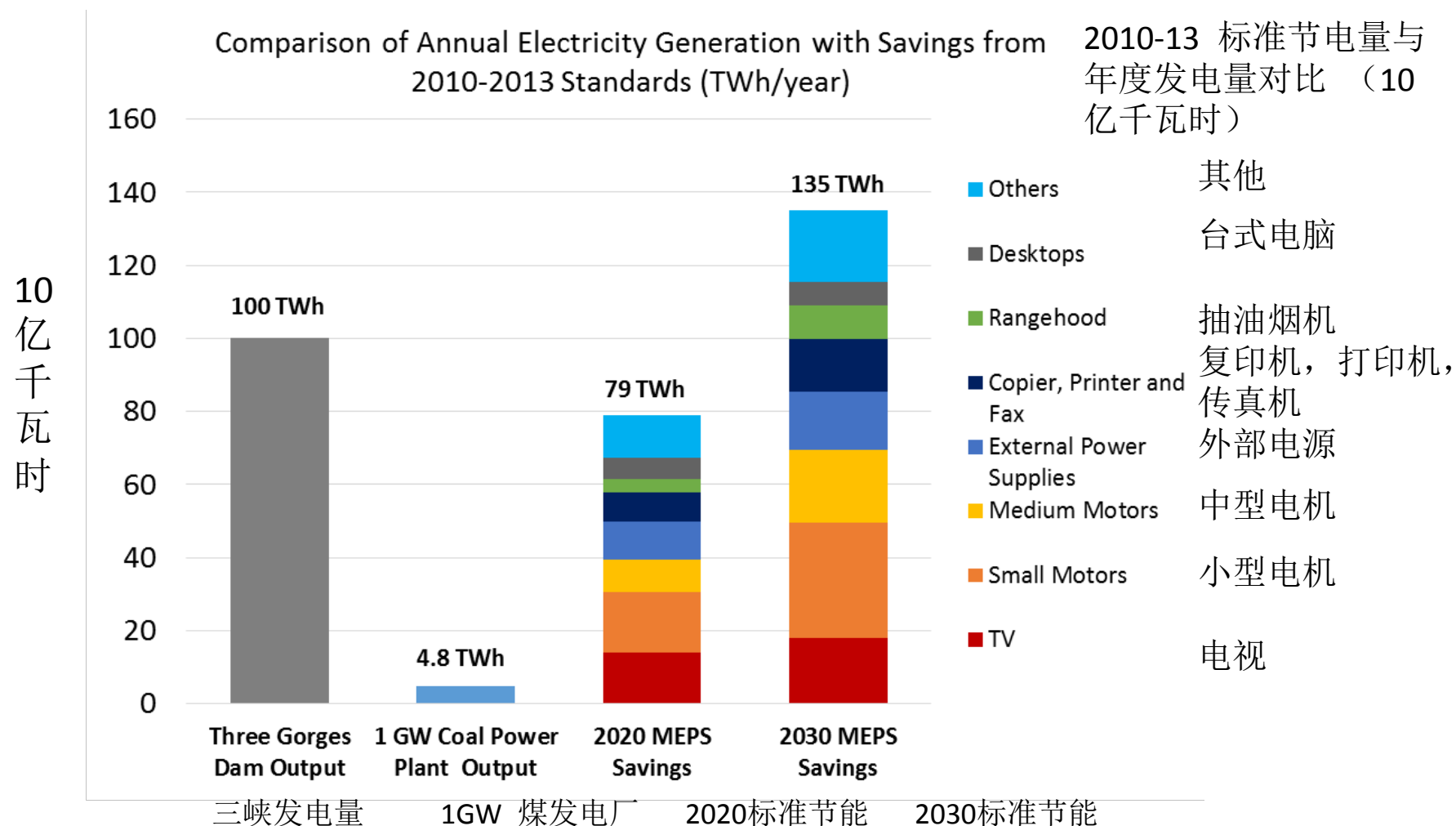
U.S. Department of Energy, Energy Efficiency and Renewable Energy. 2016. *Saving Energy and Money with Appliance and Equipment Standards in the United States*.

<http://energy.gov/sites/prod/files/2016/10/f33/>

[Appliance%20and%20Equipment%20Standards%20Fact%20Sheet-100716_0.pdf](http://energy.gov/sites/prod/files/2016/10/f33/Appliance%20and%20Equipment%20Standards%20Fact%20Sheet-100716_0.pdf)

Our bottom-up estimate of one-time impact of 23 out of 28 of China's MEPS from 2009 to 2013 showed significant savings

对23个中国最高能效标准(2009-2013)的终端节能影响分析表明节能效果显著



Note: Others include fixed speed and variable speed room AC, top-load clothes washers, microwave, laptop computer and heat pump water heaters, distribution transformers

Source: Khanna, et al. 2016. "Prospective Evaluation of Energy and CO2 Emissions Impact of China's 2010-2013 Efficiency Standards for Products." <https://china.lbl.gov/publications>

Web-crawling Applications at LBNL

LBNL的网络爬虫应用

IDEA: International Database of Efficient Appliances

国际节能电器数据库

- Use LBNL web-crawling software to collect model-level data from a wide range of online sources

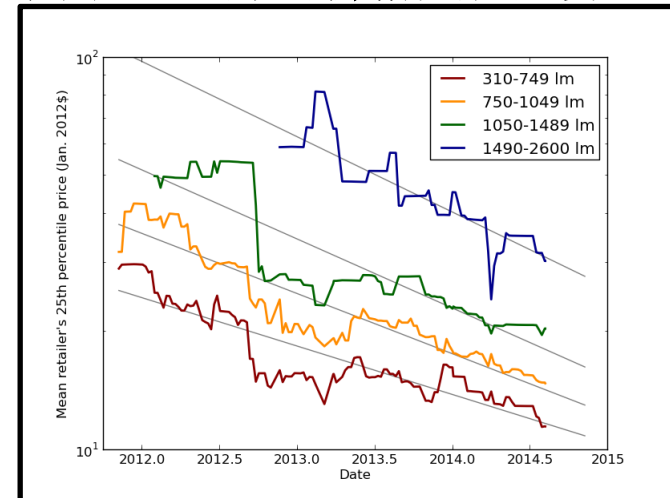
利用LBNL网络抓冲软件收集大量网上 模型数据

- Easy to update regularly at specified time intervals 容易选取时间及时更新
- Provide market assessment to support standards development 提供标准开发的市场评价
- Enables price tracking, benchmarking, monitoring of policy impacts 允许跟踪价格, 对标, 监控政策影响



U.S. Example: LED Price Evolution in the U.S.

美国案例: LED灯的价格变化趋势



Source: Gerke et al. LBNL-6854E Report

Possible IDEA applications in China

国际节能电器数据库在中国的潜在应用

- ◆ Provide real-time market data before/after standards implementation on

提供标准执行前后的实时市场数据:

- ❑ Product class distributions 产品分类的市场分布
- ❑ Energy efficiency category market shares 节能种类的市场份额
- ❑ Retail price points 零售价格

- ◆ Market analysis to establish baseline units 市场分析以建立基准线
- ◆ Analysis of standards impact on price, market efficiency distribution, and evolution of price premium for efficient products
分析标准对价格的影响, 节能市场分布, 及分析节能产品的溢价

LBLN Air Conditioner and Refrigerator Test Chambers

LBLN空调和冰箱测试间

- ◆ Refrigerator Test Chamber: Installed with data acquisition system Feb 2014
冰箱测试间: 建于2014年2月并配备数据收集系统
- ◆ Air Conditioner Test Chambers: Installed in early 2015
空调房测试间建于2015年初



Assist DOE in testing for certification, compliance, and enforcement

协助能源部测试认证, 达标执行情况

Provide test procedure rulemaking support 提供测试支持

- ❑ Research testing 研究测试
- ❑ Independent from industry and third party test labs 工业和第三方测试

Resource for appliance research at LBNL 是LBNL电器研究的资源

Thank You! 谢谢!

Contact Information 联系方法:

China Energy Group website 中国能源组网页: <https://china.lbl.gov>

U.S. Energy Efficiency Standards website 美国能效标注网页:
<https://ees.lbl.gov>



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